

DISTRIBUTION AND ABUNDANCE OF JUVENILE COHO AND STEELHEAD IN  
SCOTT AND GAZOS CREEKS IN 1993.

Jerry Smith  
Department of Biological Sciences  
San Jose State University  
San Jose, CA 95192

10 February 1994     Revised 26 February 1994

**ABSTRACT:** In January 1994 sites on Gazos Creek and in the Scott Creek watershed were electroshocked to assess distribution and abundance of 1993 year class coho. Coho were collected at 2 upstream sites (miles 3.15 and 4.4) on Gazos Creek but were absent from 2 downstream sites (miles 1.8 and 0.9). Coho were present at all 11 sites sampled in the Scott Creek watershed. Densities were highest at 5 sites on Scott Creek between Big Creek (mile 2.15) and mile 5.7; within that portion of stream coho outnumbered steelhead in the pools and glides sampled. Coho were relatively rare in steeper channels on Big Creek and upper Scott Creek, where pools were rare, and in Mill Creek, where pools were shallow. Coho were also relatively rare on lower Scott Creek, downstream of Big Creek, where pools were less common and good coho spawning habitat is absent. The strong 1993 coho year class on Scott Creek demonstrates the presence of substantial suitable coho rearing habitat. The 1993 year class could produce an estimated 69 pairs of spawning adults. The weaker year classes on Scott Creek in 1991 and 1992 and probably on Waddell Creek in 1991, 1992 and 1993 were apparently due to destruction of redds by storms and poor access due to drought in individual years from 1976 through 1992.

INTRODUCTION

Since 1981 native, wild coho (Oncorhynchus kisutch) have been confirmed for only two streams south of San Francisco, Waddell and Scott creeks in Santa Cruz County. Since all female southern coho spend one year in the stream and two years in the ocean (Shapovalov and Taft, 1954), three years of study are necessary to determine the status of the three independent year classes. On Waddell Creek, summer electroshock sampling in 1988 (Smith, unpublished) found juvenile coho to be very rare. Sampling of the next generation by smolt trapping during the later half of the migration period in 1992 collected no 1991 year class coho smolts (Smith, 1992a). However, one 1991 year class adult male was captured in February 1994 (Smith, unpublished). Therefore, one year class is at least very rare and risks extirpation, possibly in 1994. Summer electroshock sampling in 1992 (Smith, 1992b) collected only 19 juvenile coho, while sampling about 9 percent of Waddell Creek's potential coho habitat. In addition, only 119 coho smolts were collected during the second half of the downmigration period in 1993 (Smith, 1993), so a second year class was very weak. Smolt

production was probably in the low hundreds, and expected adult returns (in winter 1994-95) will probably be less than 5 pairs (at a 2% return rate). Electroshock sampling in July through December 1993 (Davis and Smith, 1993) collected more fish than in 1992, but a rough estimate of potential smolt production on Waddell Creek was only 1140, although deeper pools were not sampled. The third year class is probably capable of producing less than 15 pairs of adults.

Although coho were common on Scott Creek in 1988 (Smith, unpublished), poor access of that year class as adults in the winter of 1990-91 apparently resulted in a very weak 1991 year class. Smolt trapping by the Department of Fish and Game collected only 10 coho during part of the spring 1992 migration period (Jennifer Nelson, DFG, personal communication); few adults are likely in winter 1993-94. In 1992 an early February flood probably destroyed many coho redds, and electroshock sampling in late summer at 13 sites collected only 42 coho (Smith, 1993). Most of the coho were at 3 sites within 0.4 miles, and potential smolt production probably did not substantially exceed 1000 fish. A single 1992 coho female was spawned at the Big Creek restoration hatchery (Monterey Bay Salmon and Trout Project), and 1800 smolts were released in 1993 (Dave Streig, personal communication). Adult returns in winter 1994-95 will probably be less than 30 pairs.

Coho were present in Gazos Creek in San Mateo County in the 1970's. No recent sampling of Gazos Creek had taken place until a limited sampling (two sites) in 1992 (Smith, 1992); no coho were collected. Smolt trapping by the Department of Fish and Game also failed to collect coho (and only few steelhead (O. mykiss)) in spring of 1993 (Jennifer Nelson, DFG, personal communication).

To gather data on the 1993 coho year classes on Scott and Gazos creeks, I sampled the two streams on 12-16 January 1994.

## METHODS

Although several storms occurred in November and early December, 1993, a month of low streamflows (< 2.5 cfs) allowed sampling by backpack electroshocker on 12-16 January 1994. Both Gazos Creek sites sampled in 1992 were resampled, and two additional upstream sites were added. Eight of the 13 Scott Creek watershed sites sampled in 1992 were resampled, and 3 additional sites were added. At resampled sites most of the same sampling stations were resampled.

The primary goal of the sampling was to look for the presence of coho, so sampling was concentrated in pool and glide habitat in both years. Limited spot sampling in January 1994 indicated that most coho and steelhead were in deeper habitats, and no winter-time fish were in shallow riffles, which made up 5 - 25 percent of the habitat at each site.

At each site, usually three to five individual habitat "units" (a glide or pool, with its contiguous glide and run habitat) were sampled by 2 to 3 passes with a backpack electroshocker (Smith-Root Type 7, smooth pulse). Length, width, depth, cover (escape and overhead), and substrate conditions were determined, and percentage of habitat type assigned for each habitat unit. Channel type was determined, and relative abundance of pool, glide, run and riffle habitat types was also estimated for the site.

Fish were measured (standard length) in 5 mm increments, and young-of-year steelhead were separated from older fish, based upon length frequency. Capture and handling mortality was less than 1/2 percent, possibly due to low water temperatures (<11 degrees C).

## RESULTS

### Scott Creek

Although pools made up only about 26 percent of the habitat at the Scott Creek sites, pools made up 49 percent of the sampled habitat (Table 1). Runs and riffles made up 37 percent of the habitat, but only 19 percent of the sampled habitat.

Coho were collected at all eleven sites sampled in the Scott Creek watershed (Table 1). Amongst collected fish, coho were over 80 percent as abundant as young-of-year steelhead (376 versus 464). At the five sites sampled on Scott Creek from Big Creek upstream to the end of the dirt road (sites 2-11) coho were especially abundant. Collected coho outnumbered steelhead at four of the five sites, and estimated density of coho in the sampled habitats at the 5 sites (49.0/100 feet) exceeded that of combined young-of-year (35.8 /100 feet) and older (12.4/100 feet) steelhead. At all five sites coho were collected in pools and deeper glides, but were absent from shallower glides and from runs.

At the two sites on Scott Creek downstream of Big Creek, coho were less common, with estimated densities less than 10 percent of those upstream (Table 1). Coho at those two sites were collected only in the deepest pool at each site.

At the most upstream site on Scott Creek, the B2 channel consisted primarily of step-run and riffle habitat types (Table 1). Pools were mostly bedrock; although some were deep, complex escape cover was scarce. Coho were collected only in a deep bedrock pool; such habitat made up less than 10 percent of the site. Estimated density of coho was low (16/100 feet of sampled habitat), compared to both steelhead density and to coho densities downstream.

Habitat in Big Creek also consisted primarily of runs and riffles (Table 1). Low densities (8-9/100 feet) of coho were collected in pools at both sampled sites. However, steelhead were substantially more abundant than coho, even in pools.

Mill Creek is a small tributary, and even though pools were common at the sampled site (Table 1), they were relatively shallow. Coho were present in each of the sampled pools, but their density was relatively low (12/100 feet) compared to young- of-year steelhead (48/100 feet).

Total steelhead densities, in general, were inversely related to coho densities. At the 5 sites with the highest coho abundance, steelhead density averaged 48.2 fish per 100 feet. At the 6 sites with relatively low coho density, steelhead density averaged 67.6 fish per 100 feet.

### Gazos Creek

Pool habitat was less abundant on Gazos Creek than on flat sections of Scott Creek (Tables 1 and 2), and most pools were relatively shallow.

No coho were collected at sites 0.9 and 1.8 miles upstream of Highway 1, the sites also sampled in 1992, and only a single coho was collected at a site 3.15 miles upstream of Highway 1 (Table 2). Eight coho were collected in two pools at the site 4.4 miles upstream of Highway 1.

Total fish densities were quite low, with young-of-the-year steelhead ranging between 16 and 25 per 100 feet at three of the sites. At the fourth site, which had higher density, only 2 well-developed pools were sampled.

## DISCUSSION

Since pools on both streams were sampled at more than twice their estimated relative abundance, and riffles were almost never sampled, neither the density estimates nor the relative abundances of steelhead and coho shown in Tables 1 and 2 accurately reflect stream production. Actual coho density on both streams was probably roughly half of that shown. Regardless, two encouraging results emerge from the sampling of 1993 rearing results: 1) coho are still present in Gazos Creek; and 2) the 1993 year class of coho on Scott Creek was very strong.

### Scott Creek

The high density of juvenile coho reared on Scott Creek in 1993 demonstrates that good coho habitat is still present in Scott Creek. In particular the habitat from Big Creek (mile 2.15) upstream to approximately mile 6.15 provides abundant woody pool and glide habitat. The estimated coho density in sampled habitat at the five sites in that portion of the stream was 49.0 fish per 100 feet. If the estimated density is halved to compensate for the oversampling of pool habitat, the four mile stream section would have produced an estimated 5174 coho.

Upstream of mile 6.15 on Scott Creek and on Mill and Big creeks, the habitat is mostly runs, riffles and shallower pools, and coho density in sampled habitats averaged only 11.3 fish per 100 feet. In 1993 it appears that coho spawning may have occurred all the way upstream to waterfall barriers; on Scott Creek, at least, coho were present immediately downstream of the falls (Dave Streig, personal communication). If the estimated density was halved to compensate for oversampling of preferred pool habitat, the approximately five miles of accessible habitat on Mill and Big creeks and on Upper Scott Creek would have produced an estimated 1480 coho. That rough estimate may be too high, as suitable coho habitat (deeper pools with cover) tends to progressively decline upstream of the sampled sites.

On Scott Creek, downstream of Big Creek, coho density at the two sampled sites was relatively low, averaging only 4.5 coho per 100 feet. Pools with good cover were rarer than upstream, but few coho were found even in relatively good habitat. Good spawning habitat is scarce in the lower 3 miles of Scott Creek, so the low coho density downstream of Big Creek may also reflect low spawning success in the lower portion of the creek and poor downstream movement of fish into the lower portion of the creek. The portion of the creek downstream of Big Creek produced only an estimated 240 coho in 1993.

The rough combined estimate of coho production in the three portions of the Scott Creek watershed in 1993 is approximately 6900 fish. At a 2% return rate, approximately 69 pairs of returning adults might be expected.

Steelhead densities were generally lowest in this study where coho were abundant. Four of the 5 sites with high 1993 year class coho densities had their steelhead density drop by over half, compared to 1992 (Table 1 and Smith, 1992). Three sites with relatively few 1993 year class coho showed no significant decline in steelhead, compared to 1992. These results suggest that competitive interactions between coho and steelhead in pools and glides favor coho.

The combined results of low coho densities reared in 1991 and 1992 and high densities reared in 1993 demonstrate that the coho "problem" on Scott Creek is not primarily one of rearing habitat, but rather one of adult numbers or spawning success. Waddell Creek, although the coho numbers are lower, also shows highest coho abundance in 1993 and a weak 1992 and very weak 1991 year class.

In winter 1992-3, December through February storms allowed easy coho access to upper portions of watersheds for spawning. On both Waddell and Scott creeks coho were present in 1993 far upstream in steeper, rockier B channels, where suitable rearing pools were relatively scarce. In addition, no very large storms occurred in late winter or spring to destroy coho redds, and the early and easy access would have eliminated any significant potential marine mammal predation on adult coho. Perhaps most importantly, the

"ancestors" of the 1993 year class have faced no severe stress year (extreme drought or winter flood) for over 2 decades (1969, 1972, 1975, 1978, 1981, 1984, 1987, 1990).

The two weak year classes on Waddell and Scott creeks in 1991 and 1992 probably show the lingering impact of previous drought or flood years. The "ancestors" of the 1991 year class include the 1976 year class, which reared during a severe drought year and also probably had severely restricted smolt migration during 1977, a second severe drought year. The 1982 year class should also have been severely impacted by the January 4th storm, which produced severe watershed erosion, streambed scour and deposition, and riparian vegetation loss. The effects of the 1976-77 drought and the 1982 flood were apparently much greater for Waddell Creek than for Scott Creek; the 1988 year class on Waddell was very weak, while the coho were common on Scott Creek in 1988 (Smith, unpublished). However, drought in 1990-91 delayed sandbar opening on Scott Creek until March, apparently severely reducing the 1991 year class.

The 1992 year classes on Scott and Waddell creeks were apparently better than 1991, but were still very weak. The 1992 year classes may have been affected by the 1977 drought year and severe flooding in 1983 and 1986. In addition, the 1992 year class was probably severely impacted by the February flood in 1992.

#### Gazos Creek

The absence of coho in 1992 sampling on lower Gazos Creek does not necessarily mean the lack of a 1992 coho year class. No coho were collected at the same lower Gazos Creek sites in January 1994, even though coho were present at the two upper sites.

Pools are relatively rare and shallow on Gazos Creek, but suitable coho habitat appears to be present throughout the lower 5 miles of stream. The continuously good streamflows available from December through March in 1992-93 would have allowed spawning coho to ascend to the upper portion of the stream, although suitable spawning sites are present in the lower creek. Low coho densities at upstream spawning sites may have reduced downstream dispersal of juvenile coho to suitable rearing habitat in the lower portion of the creek.

#### Management Implications

Coho have declined in Scott and Waddell creeks, but steelhead have not apparently declined. This suggests that the coho decline must be due to factors primarily impacting coho rather than steelhead, such as ocean fishing and the effects of droughts on access and floods on survival of early winter redds. The inflexible spawning of coho females as three year olds, and early winter spawning

(Shapovalov and Taft, 1954), make coho particularly susceptible to year class loss.

Although rearing habitat on Scott and Waddell creeks could be improved, the weak coho year classes are not due to lack of adequate rearing habitat, but rather to lack of sufficient successful spawners. Insufficient spawning success in turn is probably due to past and continuing impacts of drought years (1976, 1977, 1991) and flood years (1982, 1983, 1986, 1992) upon redd survival and adult and smolt migration access. The concentration of 1992 Scott Creek coho production within 1/2 mile of stream (Smith, 1992) indicates that juvenile coho may not disperse far from the spawning site. Therefore, fully seeding rearing habitat probably requires a well-spaced spawning density of at least 2 successful pairs per mile. For Scott Creek approximately 22 pairs of successfully spawning coho might be necessary to seed the 11 miles of potential habitat; at least 8 pairs might be needed to seed the best 4 miles of habitat. For Waddell Creek approximately 12 successful pairs of coho would be necessary to seed the 6 miles of potential rearing habitat. These minimum adult numbers require well-spaced spawning distribution throughout the rearing habitat and also a lack of redd destruction or reduced hatching success due to storms or fine sediment; all of these requirements are unlikely to be met. However, on both Scott and Waddell creeks, fewer spawners would be needed to seed only the flatter habitat (C channels), where pool habitat is most abundant. Only the 1993 Scott Creek year class (estimated production of 69 pairs of adults) is clearly likely to produce an adequate number of returning adults. The hatchery-augmented 1992 Scott Creek year class (estimated 30 pairs of adults) and the 1993 Waddell Creek year class (estimated 15 pairs of adults) may be capable of adequately seeding rearing habitat and producing strong year classes. The 1991 years classes on both streams may be nearly extirpated, and the 1992 year class on Waddell Creek (estimated production of 4 pairs of adults) was extremely weak.

Augmenting the strength of the 1992 Scott and Waddell Creek year classes and the 1993 Waddell Creek year class with hatchery-reared Scott and Waddell Creek fish may be necessary to ensure the longterm survival of those year classes. The extreme scarcity of 1991 (1994) fish makes augmentation crucial; without hatchery rearing the year class may be lost in both streams. Restoration would then require manipulative production of 2 or 4 year old mature females or transplants from other native coho streams. The closest known healthy coho population is over 60 miles away in Marin County (Redwood Creek).

The most productive coho habitat is the lower 2 miles of West Fork Waddell Creek and between miles 2.15 and 6.15 on Scott Creek. The steeper upstream habitat in the Waddell Creek and Scott Creek watersheds provides little of the sheltered (woody) pool habitat preferred by coho. Because of steep, confined channel characteristics, little can be done to significantly improve habitat for coho in those portions of the streams. The downstream

portions in both watersheds (downstream of the forks on Waddell Creek and downstream of Big Creek on Scott Creek) provide limited spawning habitat likely to provide good hatching success or redd survival in flood years. Improved spawning in the downstream portion of the two creeks might substantially increase coho rearing in downstream pools. Experimental planting of fingerlings in downstream reaches could be used to evaluate rearing potential in downstream habitats, prior to any expensive attempt at spawning or rearing habitat improvement.

Sandy sediment is a habitat problem in both watersheds. On Waddell Creek, much of the sediment appears to come from the East Fork. Evaluation and control of sediment sources on Last Chance Creek and upper portions of the East Fork may improve spawning and rearing on lower Waddell Creek. Upper Big Creek appears to be a significant sediment source for Scott Creek.

The status of Gazos Creek is uncertain. Only four sites were sampled in January 1994, and coho were absent from apparently suitable habitat at the 2 downstream sites. Gazos Creek should be sampled in each of the next two years to determine the presence and year class strength of coho. The creek probably will require rebuilding of depressed (or extirpated) year classes.

The distributional pattern of coho found on Scott Creek in this study and on Waddell Creek in the study by Smith and Davis (1993) also has implications for restoration of coho in other Santa Cruz County and San Mateo County streams. Most of the cool stream habitat with good spawning substrate is in steeper channels, unlikely to provide woody pools needed for rearing high, sustainable, densities of coho. Most of the flatter stream sections, with frequent pools, have warmer water temperatures and lack the good spawning habitat necessary to permit early redds to survive the scour of large winter storms. Long-term coho restoration success is likely only in streams where abundant woody pools, cool water temperatures, and good spawning substrate occur together.

#### ACKNOWLEDGEMENTS

Jay Abel, Lanette Davis, Jennifer Nelson and Dave Streig assisted in the electroshock sampling. Bud McCrary and Kevin Piper (Cal Poly San Luis Obispo) gave permission to sample sites on Scott and Big creeks.

## LITERATURE CITED

Shapovalov, L. and A. C. Taft. 1954. The life histories of the steelhead rainbow trout (Salmo gairdneri gairdneri) and silver salmon (Oncorhynchus kisutch). California Department of Fish and Game Bulletin 98. 275 pp.

Smith, J. J. 1992a. Summary of trapping results on Waddell Creek for 1991-1992. 11 page unpublished report.

Smith, J. J. 1992b. Distribution and abundance of juvenile coho and steelhead in Waddell, Scott, and Gazos creeks in 1992. 8 page unpublished report.

Smith, J. J. 1993. Summary of trapping results on Waddell Creek for 1992-1993. 16 page unpublished report.

Smith, J. J. and L. Davis. 1993. Distribution and abundance of juvenile coho and steelhead in Waddell Creek in 1993. 7 page unpublished report.

Table 1. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet ( ) at sites on Scott Creek in January 1994.

| Site                     | Mile | Chan | %Hab Avail |    |    |    | %Hab Sampl |    |    |    | Sample Length | #SHT        |             | #Coho       |  |
|--------------------------|------|------|------------|----|----|----|------------|----|----|----|---------------|-------------|-------------|-------------|--|
|                          |      |      | PL         | GL | RN | RF | PL         | GL | RN | RF |               | 0+          | 1+          |             |  |
| A Near Diversion         | 0.9  | C3   | 25         | 55 | 15 | 5  | 40         | 45 | 15 | -  | 211'          | 91<br>(52)  | 44*<br>(24) | 4<br>(2)    |  |
| 1 <Little Creek          | 1.9  | C1   | 20         | 55 | 15 | 10 | 31         | 50 | 15 | 4  | 180           | 58<br>(34)  | 10<br>(8)   | 10<br>(7)   |  |
| Big Creek                | 2.15 |      |            |    |    |    |            |    |    |    |               |             |             |             |  |
| 2 Pullout >Big Cr.       | 2.55 | C3   | 35         | 35 | 25 | 5  | 81         | 9  | 10 | -  | 144           | 73<br>(71)  | 38<br>(28)  | 40<br>(31)  |  |
| 4 <Swanton Road          | 3.55 | C3   | 40         | 40 | 15 | 5  | 48         | 36 | 15 | -  | 124           | 47<br>(40)  | 15<br>(13)  | 103<br>(86) |  |
| 7 Pullout <Big Cr. Gate  | 4.9  | C3   | 25         | 55 | 10 | 10 | 39         | 47 | 14 | -  | 167           | 36<br>(25)  | 6<br>(5)    | 79<br>(48)  |  |
| 9 0.15 mi > bridge       | 5.15 | C3   | 15         | 55 | 20 | 10 | 41         | 38 | 21 | -  | 80            | 19<br>(24)  | 10<br>(12)  | 31<br>(39)  |  |
| 11 Upper Ford            | 5.85 | C1   | 35         | 50 | 10 | 5  | 50         | 39 | 11 | -  | 181           | 25<br>(19)  | 8<br>(4)    | 68<br>(41)  |  |
| 11A 4th Trail Xing       | 6.5  | B2   | 15         | 5  | 65 | 15 | 39         | 20 | 41 | -  | 162           | 47<br>(55)  | 13<br>(16)  | 12<br>(16)  |  |
| 12 Big Cr. Swanton Rd.   |      | C1   | 20         | 20 | 35 | 25 | 43         | 25 | 31 | -  | 157           | 49<br>(41)  | 16<br>(13)  | 13<br>(8)   |  |
| 12A Bridge < Hatchery    |      | B2   | 15         | 10 | 60 | 15 | 60         | 23 | 17 | -  | 43            | 9+<br>(9+)  | 43<br>(100) | 3<br>(9)    |  |
| 13 Mill Cr. <Swanton Rd. |      | C1   | 45         | 25 | 15 | 15 | 62         | 23 | 15 | -  | 105           | 49<br>(48)  | 6<br>(6)    | 13<br>(12)  |  |
| Totals                   |      |      | 26         | 36 | 26 | 11 | 49         | 32 | 19 | 0  | 1554          | 464         | 209         | 376         |  |
|                          |      |      |            |    |    |    |            |    |    |    |               | 673<br>(39) | (21)        | (27)        |  |

\*Includes holdover hatchery smolts

**Table 2. Site locations, habitat types present and sampled, number of steelhead and coho collected and estimated density per 100 feet ( ) at sites on Gazos Creek in August 1992 and January 1994.**

| Site    | Mile  | Chan | %Hab Avail |    |    |    | %Hab Sampl |     |    |    | Sample | #SHT | #Coho       |            |           |
|---------|-------|------|------------|----|----|----|------------|-----|----|----|--------|------|-------------|------------|-----------|
|         | >Hwy1 | Type | PL         | GL | RN | RF | PL         | GL  | RN | RF | Length | 0+   | 1+          |            |           |
| 1       | 1992  | 0.9  | C3         | 15 | 55 | 20 | 10         | 57  | 43 | -  | -      | 148' | 30          | 23         | -         |
|         | 1994  |      |            | 25 | 30 | 30 | 15         | 62  | 26 | 11 | -      | 148  | 25<br>(16)  | 15<br>(11) | -         |
| 2       | 1992  | 1.8  | C3         | 15 | 55 | 20 | 10         | 31  | 69 | -  | -      | 127  | 45          | 14         | -         |
|         | 1994  |      |            | 20 | 25 | 40 | 15         | 40  | 31 | 23 | 5      | 185  | 40<br>(22)  | 21<br>(12) | -         |
| 3       | 1994  | 3.15 | B2         | 25 | 25 | 25 | 25         | 56  | 30 | 14 | -      | 127  | 31<br>(25)  | 6<br>(5)   | 1<br>(1)  |
| 4       | 1994  | 4.4  | B2         | 20 | 35 | 25 | 20         | 100 | -  | -  | -      | 43   | 22<br>(53)  | 4<br>(9)   | 8<br>(23) |
| Totals: |       |      |            | 15 | 55 | 20 | 10         | 44  | 56 | -  | -      | 275' | 75          | 37         | -         |
|         |       |      |            | 23 | 29 | 30 | 19         | 65  | 22 | 12 | 1      | 503  | 118<br>(29) | 47<br>(9)  | 9<br>(6)  |